National Weather Service ... National Training Center

8 Inch Non-Recording

Standard Rain Gage

Introduction

The purpose of this web document is to provide information on the 8-inch non-recording standard rain gage (SRG). It describes the four major components of the gage, the installation and exposure of the gage, the use of wind shields, and measuring snowfall. It ends with a comparison of the SRG with other types of rain collectors.

Rain Gage Description

In its simplest form, an 8-inch Standard Rain Gage is an open mouth can with straight sides. Every climatological station in the "A" Network must be equipped with a SRG. Even though the SRG is preferred, the 11 inch plastic gage is an acceptable substitute in stations other than those in the "A" Network.

> At National Weather Service (NWS) Cooperative Weather Stations, the SRG is the center around which all documentation evolves. Spacial coordinates (latitude, longitude), as well as elevation, are fixed from the Standard Rain Gage location. Also, azimuth and range calculations for co-located equipment and obstructions within 200 feet are based on the SRG location. It is the primary point from which all distances and elevation angles for the station, as required on the B-44, are determined. If an 11 inch plastic rain gage is used in lieu of a SRG, it too becomes the primary point of calculations.

The 8-inch standard rain gage is a simple non recording gage consisting of four major components. These include:

- Measuring Stick
- Overflow Can
- Collector Funnel
- Measuring Tube

The 8-inch gage used in the National Weather Service is of a standardized design used throughout the world for official rainfall measurements. This standardization provides uniformity, continuity, and credibility of precipitation data worldwide.

There are two basic type of the 8-inch gage: a large capacity gage and a small capacity gage. The traditional large gage has a capacity of 20 inches whereas the smaller gage's capacity is 7 inches. The 20 inch gage is the norm throughout the National Weather Service. However, other agencies like the U.S. Forest Service often use the smaller gage. The inner measuring tube of the large NWS gage holds 2.0 inches of precipitation. The measuring tube of the small gage holds 0.50 inch. For the remainder of this document we will be referring the NWS 20 inch capacity gage.

Major Gage Components

Overflow Can

The overflow can of the Standard Rain Gage collects water when rainfall greater than 2.00 inches occurs during the observation period and overflows the measuring tube. The maximum capacity of the overflow can is 20 inches.

Standard Rain Gauge (SRG)

SRG Overflow Can

In addition to serving as an overflow collector for rainfall, the overflow can also is used as the primary collector in frozen precipitation events. When solid precipitation is expected, only the overflow can is left in place outside. Both the collector funnel and the measuring tube are removed to allow snowfall to collect directly in the overflow can. Obviously, if the funnel were left in place, snow would quickly accumulate and mound it over. Also, freezing rain would quickly plug the small orifice of the funnel.

To determining precipitation in these events, i.e., the water equivalent of solid precipitation, the solid precipitation accumulated in the overflow can is not measured directly in the overflow can. Instead, the contents of the overflow can are melted and poured into the measuring tube for measurement. This facilitates the measurement of the water content of solid precipitation to the nearest hundredth of an inch as required for precipitation measurements.

The overflow can also be used to cut snow samples for the determination of water content of snow on the ground. If ice or dense snow accumulation on the ground are persistent problems at a Cooperative Weather Station, the overflow can may be fitted with a snow cutter. This cutter is a saw-toothed piece of metal which slips over the top of the overflow can.

CAUTION

The snow cutter is very sharp and potentially dangerous, if not handled properly.

Observers issued a snow cutter should be admonished to take extreme care during use. They should also be advised to store the cutter away from children. Specific procedures for measuring solid precipitation using the SRG are outlined below.

The primary problem associated with the overflow can is leaks. Overflow cans develop leaks at the bottom and/or at vertical seams after being subjected to freezing temperatures while holding water. Some leaks are apparent upon visual inspection. Smaller leaks may require the visiting HMT to add water to the can. If leaks are detected, they must be repaired or the overflow can replaced. Therefore, it is advisable to carry spare overflow cans for replacing those found with leaks. Field repair of overflow cans is difficult and time consuming.

Collector Funnel

Two types of collector funnels are used with the SRG. Older units are made of copper while newer funnels are made of fiberglass. Rainfall is caught in the collector funnel and conducted into the measuring tube. The funnel is 8 inches in diameter with a knife edged rim. It is designed to readily slide over the overflow can. Some lock into place with 2 slots fitting over corresponding screws in the overflow can. The collector funnel also serves as a deterrent to evaporation.

The cross-sectional area of the collector is 10 times that of the measuring tube. Therefore, the depth of the water standing in the measuring tube is exactly 10 times the depth of the precipitation that has fallen.

Caution should be taken when handling the metal collector funnels. Dents in the lower edge of the funnel can make it difficult or impossible to fit over the overflow can. If necessary, a small hammer can be used to remove dents so it will fit over the can. Also, fiberglass collector funnels are easily cracked or broken, if dropped.

Collector Funnel and Measuring Tube

Measuring Tube

The measuring tube is a 20 inch tall cylindrical straight walled tube used as the receptacle for collected precipitation. It holds 2.0 inches of precipitation. Due to the cross-sectional area relationship between the collector funnel and the measuring tube, 1 inch of rainfall fills the measuring tube to a depth of 10 inches. Two types of tubes are in use. The older units are made of brass while the newer units are made of plastic. All things considered, the older brass units are better suited for NWS applications in all regions. The plastic measuring tubes are more prone to damage as the bottoms are simply glued in place The brass unit can also develop leaks from freezing temperatures.

As previously mentioned with overflow cans, measuring tubes with leaks should be replaced with spares. Leaking overflow cans and measuring tube are more easily repaired back at the office. Field repair of either is often impractical.

Measuring Stick

Precipitation is measured in the measuring tube of the Standard Rain Gage with a black laminated measuring stick approximately 24" long. The stick is graduated in white, easy to read marks every one hundredth of an inch. To measure rainfall, the stick is inserted through the orifice of collector funnel and allowed to extend to the bottom of the measuring tube. The stick should be removed immediately. The precipitation collected in the measuring tube will "wet" the stick. Read, record and report the liquid measurement to inches and hundredths (i.e., 1.34 inch).

The insertion of the stick displaces the collected water slightly upward. However, this error is considered negligible. Also, it should be understood that 0.005 inch of precipitation, one-half of one stick division, is required to wet a previously dry funnel before water will flow into the measuring tube. This unavoidable error is also considered negligible.

If the rainfall is greater than the measuring tube capacity, water will overflow into the overflow can. The measuring stick should not be used directly in the overflow can. Instead, water from the overflow can should be poured into an empty measuring tube for measurement with the stick.

Observation Taken with Measuring Stick

Measuring Stick is Calibrated 10:1

Installation of the 8-Inch Gage

Supports for the SRG are now made of aluminum. Older units are made of steel or wood. The gage support should normally be installed to where the bottom of the gage is about 10-15 inches above the ground. In areas that experience deep snow pack, however, the installed height above the ground is often significantly higher.

Ensure that the SRG is vertical with the 8 inch collector opening level. Installation stakes supplied with the new aluminum supports (see figure) are driven into the ground in a pattern which facilitates the attachment of the assembled support. When driving of stakes, ensure that the tops of all three are level before mounting the support. This will prevent distortion of the support and make installation easier. Adjustments to the alignment of the three installed stakes relative to the support can be easily accomplished with a hammer. Once the SRG support in completely installed, the SRG should be inserted into the support and leveled. This is accomplished by gently driving in the appropriate stake(s) to attain a level posture for the 8 inch opening of the SRG.

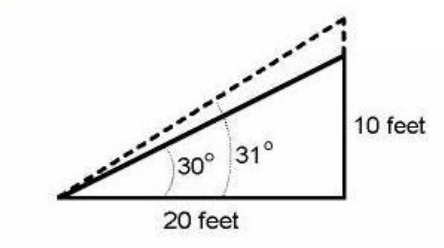
Typical Gage Support

SRG Exposure

The exposure of the rain gages is of primary importance in the accuracy of precipitation measurements, especially snowfall. An ideal exposure eliminates all turbulence and eddy currents near the gage that tend to reduce the catch, especially with increased wind speed. Rain gages **should not** be located in wide-open spaces or on elevated sites such as tops of buildings as wind and resulting turbulence will likewise reduce the precipitation catch. Roof locations are not acceptable. The **best location** for a gage is where the gage is uniformly protected in all directions, such as in an open grove of trees.

Prior to initial installation of the SRG, extreme care should be given to assuring proper exposure. Even so, one must be extremely concerned regarding obstructions which may affect the catch in the gage. As a general rule concerning an objects height and distance relationship:

The height of the projection should not exceed twice its distance from the gage.



When relating this rule to basic geometry, the projection above the gage should not exceed 30 degrees above an artificial horizon drawn across the top of the gage. An imaginary 30 degree circle surrounding the SRG should not be encroached.

Good exposures are not always permanent. Over the years, SRGs may become influenced by trees, brush, or new constructions necessitating the move of the SRG to a site having better exposure.

Proper exposure should not be compromised!

Wind Shields

SRGs are sometimes installed in locations where wind effects which reduce gage catch can not be reduced by site selection. In such cases, use of a wind shield may be advisable, particularly at stations subject to excessive snowfall.

Two type of shields have had wide use in the United States. They are the Nipher Shield, a flared metal device that attaches to the precipitation gage, and the Alter type which consists of 32 free swinging galvanized metal leaves, or baffles, attached to a steel ring 4 feet in diameter and supported by 3 or 4 galvanized pipes. One of the quadrants of the Alter's ring is hinged to allow for easy, safe access to the gage. These shields can be used on the SRG or Recording Rain gages. The installed shield's leaves should extend 1/2 inch above the level plane of the orifice. Both types of shields can greatly improve catches at very windy sites. The Alter has become the standard in the United States. The main benefit of using a wind shield occurs during snow season in windy areas.

Snowfall and the SRG

For the purposes of this document, the term snowfall also includes glaze, hail, and other forms of solid precipitation.

Snowfall is collected in the SRG's overflow can with the funnel collector and measuring tube removed. This allows snow to fall directly into can to provide a representation of the snowfall at the site. Snowfall, the depth of newly fallen snow since the last scheduled observation, is not measured directly in the overflow can. Instead, snowfall is ordinarily measured on a nearby grassy surface a short distance away from the SRG. It is also advisable to use a ***snow board*** to provide a cleared surface for determining newly fallen snow. Snow Boards are discussed thoroughly in Section 2.5.4 of Weather Service Operations Handbook #2 (WSOH02). Snowfall is measured in inches and tenths (i.e., 1.3). Even though snow measuring sticks are available, it is common practice for the SRG's measuring stick to be used where one tenth on the measuring stick equals one inch of snow.

Snowfall collected in the SRG Overflow Can is to be melted and measured in the measuring tube to provide the 24 hour precipitation. The measuring tube and measuring stick are used to allow measurement of the water content of the snowfall to be measured to the nearest hundredth of an inch as required.

SRG Comparisons with Other Rain Gages

Universal Weighing Rain Gage

Observers may encounter differences in the catch between a recording rain gage and a nearby SRG. Such differences are, in fact, typical.

Studies by Jones (1969) showed that recording rain gages, such as the Universal, with their sloping shoulders below the orifice collected 2 to 6 percent less rain than the 8" Standard Rain Gage which has straight sides. The slope of the Universal's shoulder can induce upward wind currents that may carry away some of the raindrops. Larger errors occur with snowfall.

Tipping Bucket

The tipping bucket has characteristics that can produce errors when compared to the SRG. During very light rains in warm weather, water can accumulate in the tipping bucket slowly enough to allow losses from evaporation before the bucket is tipped. During intense rainfall, some error will result as water continues to pour into the already filled bucket during the tipping motion. With an actual rainfall rate of 5 inches per hour, the recording rate in gages with a mercury switch may be 5 percent too low (Parsons 1941). This error has been reduced to about one-half this magnitude in newer types of tipping bucket gages.

The Automated Surface Observing System (ASOS) uses a tipping bucket and automatically makes a correction to the one-minute rainfall accumulation in heavy rainfall situation. Whenever more than 0.10 inch of rainfall is measured in one minute, rainfall is added to the one-minute total to compensate for the tipping bucket lose during heavy rainfall.

Review Questions

Question 1

Every __________ in the "A" network must be equipped with an 8" Standard Rain Gage.

Question 2

The Standard Rain Gage is the primary point from which all distances and elevation angles for the station are determined as required on the __________ form.

Question 3

The NWS's Standard Rain Gage has a maximum capacity of __________ inches of precipitation.

Question 4

The Standard Rain Gage's 24 inch measuring tube holds __________ inches of water.

Question 5

Read, record and report the Standard Rain Gage's liquid precipitation measurements to __________ of an inch.

Question 6

When measuring solid precipitation in the Standard Rain Gage, both the __________ and the __________ are removed to allowing snow to collect directly in the __________.

Question 7

Observers issued SRG snow cutters must be advised to store them __________.

Question 8

The primary problem associated with the overflow can is __________.

Question 9

In addition to funneling caught rainfall into the measuring tube, the collector funnel also serves as a deterrent to __________.

Question 10

A measuring tube filled to a 10 inch depth equates to __________ of precipitation.

Question 11

In areas not subject to deep snow depths, the SRG support/stand should normally be installed to where the bottom of the SRG is __________ inches above the ground.

Question 12

Rain gages __________ be located in wide-open spaces or on elevated sites such as rooftops as wind and resulting turbulence will reduce the precipitation catch.

Question 13

The best location for a rain gage is where the gage is __________.

Question 14

Referencing SRG Exposure, the height of surrounding projections should not exceed __________ its distance from the gage.

Question 15

Projections surrounding a rain gage should not encroach a conical surface that makes a __________ degree angle with earth's surface.

Question 16

When installing a wind shield on a rain gage, the installed shield's leaves should extend __________ the level plane of the SRG orifice.

Question 17

Snowfall collected in the SRG's overflow can be melted and measured in the SRG's __________ to provide the 24 hour precipitation amount.

Question 18

Precipitation is measured, recorded and reported to the nearest __________ of an inch.

Question 19

Observers __________ encounter differences in the catch between a recording rain gage and a nearby SRG. Such differences are, in fact, typical.

Answers to Review Questions for SRG Module

Question 1

Every _**climatological station**_ in the "A" network must be equipped with an 8" Standard Rain Gage.

Question 2

The Standard Rain Gage is the primary point from which all distances and elevation angles for the station are determined as required on the _**B-44**_ form.

Question 3

The NWS's Standard Rain Gage has a maximum capacity of _**20**_ inches of precipitation.

Question 4

The Standard Rain Gage's 24 inch measuring tube holds _**2.00**_ inches of water.

Question 5

Read, record and report the Standard Rain Gage's liquid precipitation measurements to _**inches and hundredths**_ of an inch.

Question 6

When measuring solid precipitation in the Standard Rain Gage, both the _**collector funnel**_ and the _**measuring tube**_ are removed to allowing snow to collect directly in the _**overflow can**_.

Question 7

Observers issued SRG snow cutters must be advised to store them _**away from children**_.

Question 8

The primary problem associated with the overflow can is _**leaks**_.

Question 9

In addition to funneling caught rainfall into the measuring tube, the collector funnel also serves as a deterrent to _**evaporation**_.

Question 10

A measuring tube filled to a 10 inch depth equates to _**1.00**_ of precipitation.

Question 11

In areas not subject to deep snow depths, the SRG support/stand should normally be installed to where the bottom of the SRG is _**10 to 15**_ inches above the ground.

Question 12

Rain gages _**should not**_ be located in wide-open spaces or on elevated sites such as rooftops as wind and resulting turbulence will reduce the precipitation catch.

Question 13

The best location for a rain gage is where the gage is _**uniformly protected in all directions**_.

Question 14

Referencing SRG Exposure, the height of surrounding projections should not exceed _**twice**_ its distance from the gage.

Question 15

Projections surrounding a rain gage should not encroach a conical surface that makes a _**30**_ degree angle with earth's surface.

Question 16

When installing a wind shield on a rain gage, the installed shield's leaves should extend _**one half inch above**_ the level plane of the SRG orifice.

Question 17

Snowfall collected in the SRG's overflow can be melted and measured in the SRG's _**measuring tube**_ to provide the 24 hour precipitation amount.

Question 18

Precipitation is measured, recorded and reported to the nearest _**hundredth**_ of an inch.

Question 19

Observers _**may**_ encounter differences in the catch between a recording rain gage and a nearby SRG. Such differences are, in fact, typical.

Last reviewed or updated on 7/28/99